OXFORD
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INTERNATIONAL A-LEVEL PHYSICS

PH05 Paper 5
Report on the examination

January 2019

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REPORT ON EXAMINATION: INTERNATIONAL A-LEVEL PHYSICS PH05 UNIT 5 JANUARY 2019

GENERAL

This was the second sitting of this examination and the cohort for it was small. Comments about typical answers should be viewed in the light of the sample size being very small.

Section A of the paper seemed to be very accessible to the students. Section B (synoptic questions) was found to be much more challenging. It was pleasing to see the continued improvement in the level of comfort with practical and data analysis questions as these had been relatively poorly answered in the first few examinations in the specification. The most challenging practical question was question 2. Students were clearly less experience when dealing with a curved best fit line and they are still reluctant to show their data extraction on the graph is a clear way. This is regarded as being essential. There was some improvement in student's ability to describe experimental procedure (question 3) and a distinct improvement in plotting and interpreting graphs (question 4)

Mathematical questions continue to be answered better than written explanations. As always, successful mathematical work is usually characterised by careful and systematic setting out. In general, students used significant figures reasonably well, particularly in calculating an using log values. Dealing with errors and uncertainties still provides a challenge to some students. The Practical Handbook, available on the specification website gives good guidance about expectations in this regard.

The synoptic nature of the paper also provides a challenge to students. When they are expected to recognise appropriate material from any of the other units, they sometimes fail to do so. Students should read the questions carefully. When they are asked to explain a phenomenon in terms of a particular idea, they will get very little credit if they do not explore that idea.

QUESTION 01

In part 1.1, students found the average correctly but did not seem to know that half of the range is understood to be the absolute uncertainty in situations of this type. Centres should refer to the Practical Handbook.

Most students did 1.2 and 1.3 correctly.

There were also quite a few correct solutions to 1.4 but many students did not aggregate the uncertainties by adding the relevant percentage uncertainties.

In 1.5, most of the students realised that the uncertainty would be reduced but few explained that this was because the absolute uncertainty in t would be reduced as the absolute uncertainty in that measurement would be the same but t itself would be larger.

QUESTION 02

In 2.1, many students did not adequately draw a best fit line that is curved.

Most of the students were unable to gain full marks in 2.2 because they did not show the data extraction from the graph in an appropriate way.

In 2.3, only a minority of students realised that the work done is the area under the appropriate part of the curve. Those that did performed the calculation well.

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QUESTION 03

In 3.1, most of the students drew circuits that were possible but a few placed the voltmeter in a position which would have made the experiment impossible.

All of the students gained some credit for 3.2 but complete answers were rare. Students should be encouraged to describe how to change one variable and to give suitable ranges of values as well as specifying how many sets of results to take. It is also expected that students will describe graphical methods of processing results, including, where relevant, the significance of intercepts and gradients. To gain credit for suggesting repeating measurements, students must be specific about which readings are repeated and they must mention the averaging of those measurements.

In 3.3, most of the students recognised that the emf would not be affected. Some realised that, as the number of cells increased, the total internal resistance would decrease but the expectation was that students would specify that *r* is inversely proportional to the number of cells.

QUESTION 04

4.1 was well done by most students. Good setting out of algebra was often evident.

4.2 was also generally well done. A very few students failed to keep to an appropriate number of significant figures (3 or 4 was expected here) or failed to keep the significant figures consistent within a column.

In 4.3, many students plotted good graphs but there were a surprising number of significant errors. Some students reversed the axes and others chose inappropriate scales. Students should be reminded that the choice of scales should not make plotting or interpolation difficult. Examples of good choices would be increments of 1, 2 or 5 per cm square. Increments of 3 or 7 would be totally unacceptable and may also cause students to be unable to gain the marks available for accurate plotting. There were also quite a few simple plotting errors. Choices of best fit lines were generally satisfactory but there were some unbalanced lines and some dot-to-dot lines. It is recommended that small crosses be used for plotting points.

Few students showed their extraction of data from the graph adequately in part 4.4. Using data points from the table is not acceptable. It is expected that students select two convenient, widely separated points on the best fit line, draw a triangle or guidelines from those points. If that working is not seen students are unlikely to be able to gain full credit. Many students did not recognise that the logarithm on the ordinate is dimensionless and this caused them to misidentify the unit.

In 4.5, many students found the appropriate log values from the graph but many could not work back to find resistances from those values.

In 4.6, most students managed one suitable suggestion about range of temperatures, sensitivity or response time. However, students should be guided by the mark allocation and expect to give more than one statement if there is more than one mark.

QUESTION 05

In 5.1, most of the students realised that the internal energy of the gas would increase as it was heated but few went on to consider what would happen to the gas as it escaped.

Many students were completely successful with the calculation in 5.2. Those that were not tended to use $pV = nRT$ without also using the Avagadro number of they failed to convert the temperature to Kelvin.

In answering 5.3, most of the students mentioned that the appropriate equation only applies to ideal gases.

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Students tended to struggle to suggest mechanisms, such as sound waves or convection, by which the air could disturb the mirrors in 5.4.

Many students did not attempt 5.5 although some managed to explain the conditions for interference and the necessary change in path length.

5.6 was not answered well. The students who did not attempt the previous part could not progress with this part either.

Only a minority of students could describe the damping of oscillations in part 5.7.

In 5.8, the possibilities of avoiding local disturbance or providing confirmation or of effectively repeating and averaging measurements did not occur to many students.

QUESTION 06

In 6.1, most of the students tended to answer in terms of ordinary efficiency. Fewer seemed to realise that not all of the kinetic energy of the wind could be extracted by the turbine or, that if it were all to extracted then the stationary air at the turbine would impede the air approaching the turbine.

In 6.2, most of the students omitted the factor of 16/27 from their calculation and few attempted to make a mathematical comparison of the two yields.

There were some good attempts at 6.3 either using force × distance or by using change in potential energy.

There were many complete and good answers to 6.4. Most of the students realised that the period would increase and most gave an appropriate justification, sometimes via Kepler's Laws.

In 6.5, most of the students realised that there was an increase in the length of the Earth's day and a good number could provide some justification in terms of the conservation of angular momentum.

QUESTION 07

Despite there being a clear space for a calculation in 7.1, few students calculated the half-life of the americium.

In 7.2, students were expected to answer in terms of the penetrative power of alpha particles but only a minority did so.

In 7.3, only a minority of students used the information provided in the question. Many tried to use $A = \lambda N$ or other numbers to arrive at the required numerical answer. Students should be reminded that they need to give their answer to more significant figures than the target number in order to show that the answer is approximately equal to that target.

Most of the students had the right idea of how to approach 7.4 but they tended to forget that, if there are 7.0×10^9 ion pairs then there will be 1.4×10^{10} charge carriers.

In 7.5, only a minority of students realised that they needed to divide the alpha particle energy by the energy transferred per mm of the path.

7.6 was very well answered but a small number of students confused number of neutrons with proton number. These students gained partial credit for correctly identifying the nucleon numbers in the equation.

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